# Appendix

In this part of the text, you can find some details of the topics treated in this book.

## Appendix A: Code for the link between Aspen Plus and MS Excel®

```
  Public Sub REGENERATIVE_RANKINE_CYCLE()


  Dim Power_Plant As IHapp
 Set Power_Plant = GetObject("SIMULATOR FILE ROUTE\FILE NAME.bkp")
  Power_Plant.Visible = True
  Power_Plant.SuppressDialogs = True

  'DECISION VARIABLES TRANSFER FROM EXCEL TO ASPEN PLUS


  Dim Boiler_Temp As IHNode, Boiler_Pres As IHNode, TurbHP_Pres As
IHNode, TurbIP_Pres As IHNode, TurbLP_Pres As IHNode, Pump_Pres As
IHNode, Div1_Frac As IHNode, Div2_Frac As IHNode


    Set  Boiler_Temp  =  Power_Plant.Tree.FindNode("\Data\Blocks\
BOILER\Input\TEMP")
    Set  Boiler_Pres  =  Power_Plant.Tree.FindNode("\Data\Blocks\
BOILER\Input\PRES")
    Set  TurbHP_Pres  =  Power_Plant.Tree.FindNode("\Data\Blocks\
TURB-HP\Input\DELP")
```



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https://doi.org/10.1007/978-3-319-91722-1

```
    Set  TurbIP_Pres  =  Power_Plant.Tree.FindNode("\Data\Blocks\
TURB-IP\Input\DELP")
    Set  TurbLP_Pres  =  Power_Plant.Tree.FindNode("\Data\Blocks\
TURB-LP\Input\DELP")
    Set Pump_Pres = Power_Plant.Tree.FindNode("\Data\Blocks\PUMP\
Input\PRES")
   Set Div1_Frac = Power_Plant.Tree.FindNode("\Data\Blocks\SPLIT1\
Input\FRAC\3")
   Set Div2_Frac = Power_Plant.Tree.FindNode("\Data\Blocks\SPLIT2\
Input\FRAC\6")

  Boiler_Temp.Value = Sheets("DV to Aspen Plus").Range("C3")
  Boiler_Pres.Value = Sheets("DV to Aspen Plus").Range("C4")
  TurbHP_Pres.Value = Sheets("DV to Aspen Plus").Range("C5")
  TurbIP_Pres.Value = Sheets("DV to Aspen Plus").Range("C6")
  TurbLP_Pres.Value = Sheets("DV to Aspen Plus").Range("C7")
  Pump_Pres.Value = Sheets("DV to Aspen Plus").Range("C8")
  Div1_Frac.Value = Sheets("DV to Aspen Plus").Range("C9")
  Div2_Frac.Value = Sheets("DV to Aspen Plus").Range("C10")

  Power_Plant.Reinit     'REINITIALIZE ASPEN PLUS
  Power_Plant.Run        'ACTIVATE ASPEN PLUS

  'DATA TRANSFER FROM ASPEN HYSYS TO EXCEL


  Dim Boiler_Q As IHNode, TurbHP_W As IHNode, TurbIP_W As IHNode,
TurbLP_W As IHNode, Tower_Q As IHNode, Pump_W As IHNode, Boiler_
Cost As IHNode, Tower_Cost As IHNode, Boiler_Op_Cost As IHNode


   Set Boiler_Q = Power_Plant.Tree.FindNode("\Data\Blocks\BOILER\
Output\QNET")
  Set TurbHP_W = Power_Plant.Tree.FindNode("\Data\Blocks\TURB-HP\
Output\WNET")
  Set TurbIP_W = Power_Plant.Tree.FindNode("\Data\Blocks\TURB-IP\
Output\WNET")
  Set TurbLP_W = Power_Plant.Tree.FindNode("\Data\Blocks\TURB-LP\
Output\WNET")
    Set  Tower_Q  =  Power_Plant.Tree.FindNode("\Data\Blocks\TOWER\
Output\HX_DUTY")
    Set  Pump_W  =  Power_Plant.Tree.FindNode("\Data\Blocks\PUMP\
Output\WNET")
    Set  Boiler_Cost  =  Power_Plant.Tree.FindNode("\Data\Blocks\
BOILER\Output\UTIL_COST")
```

```
  Set Tower_Cost = Power_Plant.Tree.FindNode("\Data\Blocks\TOWER\
Output\UTL_COST")

  Sheets("Data from Aspen Plus").Range("C3") = Boiler_Q.Value
  Sheets("Data from Aspen Plus").Range("C4") = TurbHP_W.Value
  Sheets("Data from Aspen Plus").Range("C5") = TurbIP_W.Value
  Sheets("Data from Aspen Plus").Range("C6") = TurbLP_W.Value
  Sheets("Data from Aspen Plus").Range("C7") = Tower_Q.Value
  Sheets("Data from Aspen Plus").Range("C8") = Pump_W.Value
  Sheets("Data from Aspen Plus").Range("C9") = Boiler_Cost.Value
  Sheets("Data from Aspen Plus").Range("C10") = Tower_Cost.Value

  End Sub
```

## Appendix B: Code for the link between SuperPro Designer® and MS Excel®

```
  Public Sub SetAdReadStarchFlowrate()
  Dim str1, str2, str3, str4 As String
  Dim var1, var2, var3, var4, var5, var6 As Variant
  Set DocObj1 = GetObject("SIMULATOR FILE ROUTE\FILE NAME.spf")
  var1 = Worksheets("DV to Aspen Plus").Range("C3")
  var2 = Worksheets("DV to Aspen Plus").Range("C4")
  var3 = Worksheets("DV to Aspen Plus").Range("C5")
  var4 = Worksheets("DV to Aspen Plus").Range("C6")
  str1 = "S-101"
  str2 = "S-102"
  str3 = "S-110"
  str4 = "S-115"
  DocObj1.SetStreamVarVal str1, VarID.temperature_VID, var1, str1
  DocObj1.SetStreamVarVal str1, VarID.pressure_VID, var2, str1
  DocObj1.SetStreamVarVal str2, VarID.temperature_VID, var3, str2
  DocObj1.SetStreamVarVal str2, VarID.pressure_VID, var4, str2
  DocObj1.DoMEBalances var1, var2, var3, var4, var5, var6
  DocObj1.DoEconomicCalculations
  DocObj1.GetStreamVarVal str3, VarID.HeatRate_VID, var5, str3
  DocObj1.GetStreamVarVal str4, VarID.massFlow_VID, var6, str4
  Worksheets("Data from Aspen Plus").Range("C3") = var5
  Worksheets("Data from Aspen Plus").Range("C4") = var6

  End Sub
```

# Appendix C: Code for the link between MS Excel® and MATLAB®

### File 1: Function name and linker program file route

```
function F=g(pop)
pop

excelObject=actxserver('Excel.Application');
excelObject.Workbooks.Open ('LIKER FILE ROUTE\FILE NAME.xlsm')
hworkbook=excelObject.workbooks;
F=excelObject.Run ('Rankine',pop(1),pop(2))
hworkbook.Close;
F=-F
```

### File 2: Optimization parameters and function call

```
clc;
clear;
lb=[100 5]';
ub=[500 100]';
opts   =   gaoptimset('Generations',10,'PopInitRange',[0   0;500
100],'PopulationSize',10,'EliteCount',2,'CrossoverFraction',0.8,'
TimeLimit',Inf,'StallGenLimit',Inf,'StallTimeLimit',inf,'Display'
,'iter','PlotFcns',@gaplotbestf);
[x,fval,reason,output] = ga(@g,2,[],[],[],[],lb,ub,[],opts)
```

# Bibliography


AspenTech. (2009). *Aspen Process Evaluator User's Guide, V7.1*. s.l.: Aspen Technology Inc.

AspenTech. (2015). *Aspen Plus User's Guide, V8.8*. s.l.: Aspen Technology Inc.

Bamufleh, H. S., Ponce-Ortega, J. M., & El-Halwagi, M. M. (2013). Multi-objective optimization of process cogeneration systems with economic, environmental, and social tradeoffs. *Clean Technologies and Environmental Policy, 15*(1), 185–197.

Birnbaum, D. (2005). *Excel VBA programming for the absolute beginner*. Boston, MA: Thomson Course Technology PTR.

Coello-Coello, C. A., Van-Veldhuizen, D. A., & Lamont, G. B. (2002). *Evolutionary algorithms for solving multi-objective problems*. New York, NY: Kluwer Academic.

Contreras-Zarazúa, G., et al. (2016). Multi-objective optimization involving cost and control properties in reactive distillation processes to produce diphenyl carbonate. *Computers & Chemical Engineering, 105*, 185–196.

Devillers, J. (1996). *Genetic algorithms in molecular modeling*. San Diego, CA: Academic Press.

Feng, Y., & Rangaiah, G. P. (2011). *Evaluating capital cost estimation programs*. Singapore: National University of Singapore.

Gen, M., & Cheng, R. (1997). *Genetic algorithms and engineering design*. Ashikaga: Wiley.

Goldberg, D. E. (1989). Genetic algorithms and Walsh functions: Part I, A gentle introduction. *Complex Systems, 3*, 129–152.

Gómez-Ríos, D., Barrera-Zapata, R., & Ríos-Estepa, R. (2017). Comparison of process technologies for chitosan production from shrimp shell waste: A techno-economic approach using Aspen Plus. *Food and Bioproducts Processing, 103*, 49–57.

González-Bravo, R., Nápoles-Rivera, F., Ponce-Ortega, J. M., & El-Halwagi, M. M. (2016). Multiobjective optimization of dual-purpose power plants and water distribution networks. *ACS Sustainable Chemistry & Engineering, 4*(12), 6852–6866.

Guo, H., et al. (2014). Differential evolution improved with self-adaptive control parameters based on simulated annealing. *Swarm and Evolutionary Computation, 19*, 52–67.

Gutiérrez-Arriaga, C. G., Serna-González, M., Ponce-Ortega, J. M., & El-Halwagi, M. M. (2013). Multi-objective optimization of steam power plants for sustainable generation of electricity. *Clean Technologies and Environmental Policy, 15*, 551–556.

Gutiérrez-Arriaga, C. G., et al. (2015). Industrial waste heat recovery and cogeneration involving organic Rankine cycles. *Clean Technologies and Environmental Policy, 17*(3), 767–779.

Haas, M. J., McAloon, A. J., & Ye, W. C. (2006). A process model to estimate biodiesel production costs. *Bioresource Technology, 97*, 671–678.




J. M. Ponce-Ortega, L. G. Hernández-Pérez, *Optimization of Process Flowsheets through Metaheuristic Techniques*,
https://doi.org/10.1007/978-3-319-91722-1

Hauck, M., Herrmann, S., & Spliethoff, H. (2017). Simulation of a reversible SOFC with Aspen Plus. *International Journal of Hydrogen Energy, 42*(15), 10329–10340.

Hock, W., & Schittkowski, K. (1981). *Test examples for nonlinear programming codes*. New York, NY: Springer-Verlag.

Huang, Y. Y. (2010). *Analysis of capital cost estimation methods and computer programs*. Singapore: Department of Chemical & Biomolecular Engineering, National University of Singapore.

Kirkpatrick, S., Gelatt, C. D., & Vecchi, M. P. (1983). Optimization by Simulated Annealing. *Science, 220*(4598), 671–680.

Martinez-Gomez, J., Nápoles-Rivera, F., Ponce-Ortega, J. M., & El-Halwagi, M. M. (2017). Optimization of the production of syngas from shale gas with economic and safety considerations. *Applied Thermal Engineering, 110*, 678–685.

Medina-Herrera, N., Tututi-Avila, S., Jiménez-Gutiérrez, A., & Segovia-Hernández, J. G. (2017). Optimal design of a multi-product reactive distillation system for silanes production. *Computers & Chemical Engineering, 105*, 132–141.

Morgan, J. C., et al. (2017). Thermodynamic modeling and uncertainty quantification of $CO_2$-loaded aqueous MEA solutions. *Chemical Engineering Science, 168*, 309–324.

Ouyang, A., et al. (2015). A novel hybrid multi-objective population migration algorithm. *International Journal of Pattern Recognition and Artificial Intelligence, 29*(01), 1559001.

Pauls, J. H., Mahinpey, N., & Mostafavi, E. (2016). Simulation of air-steam gasification of woody biomass in a bubbling fluidized bed using Aspen Plus: A comprehensive model including pyrolysis, hydrodynamics and tar production. *Biomass and Bioenergy, 95*, 157–166.

Ponce-Ortega, J. M., Nápoles-Rivera, F., El-Halwagi, M. M., & Jiménez-Gutiérrez, A. (2012). An optimization approach for the synthesis of recycle and reuse water integration networks. *Clean Technologies and Environmental Policy, 14*(1), 133–151.

Ponce-Ortega, J. M., Serna-González, M., & Jiménez-Gutiérrez, A. (2009). Use of genetic algorithms for the optimal design of shell-and-tube heat exchangers. *Applied Thermal Engineering, 29*(2–3), 203–209.

Quiroz-Ramírez, J. J., et al. (2017a). Multiobjective stochastic optimization approach applied to a hybrid process production–separation in the production of biobutanol. *Industrial & Engineering Chemistry Research, 56*(7), 1823–1833.

Quiroz-Ramírez, J. J., et al. (2017b). Optimal selection of feedstock for biobutanol production considering economic and environmental aspects. *ACS Sustainable Chemistry & Engineering, 5*, 4018–4030.

Sandler, S. I. (2015). *Using Aspen Plus in thermodynamics instruction* (1st ed.). Hoboken, NJ: Wiley.

Santibañez-Aguilar, J. E., Morales-Rodriguez, R., González-Campos, J. B., & Ponce-Ortega, J. M. (2016). Stochastic design of biorefinery supply chains considering economic and environmental objectives. *Journal of Cleaner Production, 136*, 224–245.

Segovia-Hernández, J. G., & Gómez-Castro, F. I. (2017). *Stochastic process optimization using Aspen Plus®*. s.l.: s.n.

Seider, W. D., Seader, J. D., & Lewin, D. R. (2010). *Product and process design principles* (3rd ed.). New York, NY: Wiley.

Sharma, S., Rangaiah, G. P. & Cheah, K. S. (2012). Multi-objective optimization using MS Excel with an application to design of a falling-film evaporator system. Food and Bioproducts Processing, 90(2), 123–134.

Sharma, S., & Rangaiah, G. P. (2013). An improved multi-objective differential evolution with a termination criterion for optimizing chemical processes. *Computers & Chemical Engineering, 56*, 155–173.

Sharma, S., & Rangaiah, G. P. (2014). Hybrid approach for multiobjective optimization and its application to process engineering problems. In J. Valadi & P. Siarry (Eds.), *Applications of metaheuristics in process engineering* (pp. 423–444). s.l.: Springer International Publishing.

Sharma, S., & Rangaiah, G. P. (2016). Mathematical modeling simulation and optimization for process design. In G. P. Rangaiah (Ed.), *Chemical process retrofitting and revamping: Techniques and applications* (pp. 99–128). Singapore: Wiley.

Sinnott, R. K., & Towler, G. (2009). *Chemical engineering design* (5th ed.). Burlington, MA: Butterworth and Heinemann.

Turton, R., Bailie, R. C., Whiting, W. B., & Shaeiwitz, J. A. (2009). *Analysis, synthesis, and design of chemical processes* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Ulrich, G. D., & Vasudevan, P. T. (2004). *Chemical engineering process design and economics – a practical guide* (2nd ed.). Durham, NH: Process Publishing.

Vasudevan, P. T., & Agrawal, D. A. (1999). Software package for capital cost estimation. *Chemical Engineering Education, 33*(3), 254–256.

Wang, X., & Tang, L. (2013). Multiobjective operation optimization of naphtha pyrolysis process using parallel differential evolution. *Industrial & Engineering Chemistry Research, 52*(40), 14415–14428.

Woinaroschy, A. (2009). Simulation and optimization of citric acid production with SuperPro designer using a client-server interface. *CHIM, 9*, 979–983.

Wong, C. L. (2010). *Development and application of a capital cost estimation program*. Singapore: Department of Chemical & Biomolecular Engineering, National University of Singapore.

Wong, J. Y., Sharma, S., & Rangaiah, G. P. (2016). Design of shell-and-tube heat exchangers for multiple objectives using elitist non-dominated sorting genetic algorithm with termination criteria. *Applied Thermal Engineering, 93*, 888–899.

## Websites

aspentech.com
honeywellprocess.com
intelligent.com
mathworks.com
microsoft.com
psenterprise.com
software.schneider-electric.com

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J. M. Ponce-Ortega, L. G. Hernández-Pérez, *Optimization of Process Flowsheets through Metaheuristic Techniques*,
https://doi.org/10.1007/978-3-319-91722-1